The discussion of rudimentary organs from the author's point of view (p. 162 *et seq.*) is one of the best illustrations of the effect of introducing ultra-scientific "explanations" into the domain of natural science that will be found throughout the book. These organs are not vestigial, but prophetic. Such a rudiment

> "may be where it is—simply because it indicates an original direction of growth, or of development, which was made part of the vertebrate Plan from the beginning of the series, for the very reason of its potential adaptability to an immense variety of purposes. Moreover, the arrest of such tendencies of growth, at a given point in the series, may well have been part of the same Plan from the beginning" (pp. 175-176).

The general public, who have hitherto been accustomed to consider the essence of the theory of evolution to be contained in the statement that man is descended from a tailed ancestor, will no doubt hail this statement of the Duke's with acclamation, because the rudimentary tail (which is discussed on p. 157) may after all be only "an arrested tendency of growth." The other logical alternative, that it is a preparation for a tail to be developed by generations yet unborn, is quite legitimate from this point of view, but the author will doubtless not insist upon this deduction. Similarly the rudimentary teeth and pelvic limbs of whales, which are also somewhat fully considered, are not necessarily vestigial in the sense of being the remnants of structures that were at one time functional. These rudiments are likewise to be regarded as "arrested tendencies of growth," or else as predetermined preparations for the transformation of whales into land animals. Honestly we prefer the Darwinian explanation—even though we have to face the difficulty of the electric organs of the Torpedo.

We have discussed these essays in the spirit of controversy because they are purely controversial in character. They have been considered also at greater length than their scientific importance warrants. Strictly speaking, it is difficult to see what class of readers are influenced by writings of this kind; certainly not working biologists of any school of thought. But the unlimited hospitality extended by the editors of high-class popular magazines to essayists of the calibre of the author of the present work, shows that such writers have the public ear, and it seems desirable to let the public know that the authority which is wielded by these knights of the pen is not conferred by those whose special studies in the field of biology might be reasonably supposed to give them the right of conferring such authority. There are some minds that may be satisfied with the word "Plan" as an all-sufficient explanation of natural mysteries yet unsolved. Like "the blessed word Mesopotamia," it may convey much comfort to such minds; but the earnest seeker after scientific truth will not be deluded, and he will still go on groping his way towards a knowledge of the processes by which the universe has been evolved by the only legitimate methods of observation, experiment, induction and deduction. It may be that, as Darwin long ago suggested, a definite set of characters undergoing selection may by inheritance tend to go on varying in the same direction, and so give to the course of development an impetus as though from some internal agency. But this agency would be only apparent, and not real in the sense of being a special entity. It would be a necessary consequence of heredity combined with other properties of living organisms which are "internal" in the same sense that crystalline form is due to the play of internal forces, and in no other sense. If, as the recent investigations of Prof. Karl Pearson seem to show, there is a tendency on the part of a race to undergo change in a definite direction, this tendency is the necessary consequence of correlation between fertility and other characters of the organism. To say that the laws of inheritance are the expressions of a preconceived Plan may be a statement of pious opinion, but as a scientific explanation it is quite devoid of value.

R. MELDOLA.

THE TIDES POPULARLY AND PROPERLY TREATED.

The Tides and Kindred Phenomena in the Solar System. By Prof. G. H. Darwin, Plumian Professor of Astronomy, Cambridge. Pp. xviii + 342. (London: John Murray, 1898.)

WHEN a man of unequivocal scientific eminence lays aside the technicalities which have assisted him along the path of important investigations, and attempts to reveal as much as may be of his subject to the wide public who cannot understand mathematical processes, the result is certain to be at least interesting. And especially is this so in the case of a subject at once so fascinating and so perplexing as that of the tides. A phenomenon of such evident significance in the economy of the globe, of such important influence on the interests of maritime communities, must necessarily have been under observation from the earliest times. Naturally the conscientious pre-Newtonian philosopher could not do more than recognise a more or less indefinite connection between the periodic alternations of sea-level and the positions of the moon and sun. And if his mind happened to be of that type which trusts more readily to speculation than to accurate observation, his theories were even less enlightened in a corresponding degree. Even after the genius of Newton had laid a foundation of rational hypothesis, the theory which remained with little modification or development until a comparatively short time ago, was one which on many essential points was absolutely contradicted by facts. Now this is the theory of which a rather inadequate description is included in some popular works on astronomy, whose most conspicuous failing in general is that they attempt to cover a far wider range than is really practicable. However that may be, a short chapter in a work of this character was practically the only place where information on tidal phenomena was to be found in a popular form, with the exception, of course, of Lord Kelvin's admirable popular lectures. In consequence, the subject of the tides is perhaps the one about which, more than any other, the most widespread misapprehension exists, even among persons who are otherwise fairly well informed. The present work therefore fills a manifest need, and Prof. Darwin is certainly right in thinking "that there are many who would like to understand the tides, and will make the attempt to do so, provided the exposition be sufficiently simple and clear." His dictum, that "a mathematical argument is, after all, only organised common sense," is indisputable, but so far from making the task undertaken in any way easier, it really emphasises the enormous difficulty. But Prof. Darwin has avowedly taken pains to render an intricate subject intelligible, and it will probably be generally agreed that he has achieved an unqualified success.

In publishing in book form the lectures which were delivered last year at the Lowell Institute, Boston, Massachusetts, the author has been distinctly well-advised to recast their form, and to eliminate all traces of the lecture-room. It is surely evident that there is one style appropriate to the platform and another to the essay, and that the two are of necessity mutually incompatible. It appears very unfortunate that the habit of publishing lectures in the form in which they have been delivered is becoming so prevalent. The result is that a little trouble is saved on the part of the author, always more or less to the detriment of his work. Is it easy, for example, to imagine a more irritating book than Tyndall's "Sound"? No doubt that is an extreme case, but the personal form of address is always objectionable to the reader, and ought to be eliminated.

As soon as one begins to examine the book in detail, one is struck by the excellence of Prof. Darwin's judgment in the choice and arrangement of his subject-matter. A liberal and comprehensive interpretation is placed upon the scope of tidal and kindred phenomena, so that a wide field of recent investigation is surveyed. But cognate branches and developments are always displayed in due order and significance of relation, and digressions, as they may appear to be at first sight, will be found in reality to be in perfect harmony with a continuous purpose.

The book begins where physical inquiry ought always to begin, in methods of observation: this course has the further advantage that the reader is not dismayed by difficulties at the outset. The construction and use of gauges for recording marine tides having been explained, the study of the changes of level in lakes is introduced in the second chapter. These Seiches, as they are called, constitute a distinct and exceedingly interesting phenomenon, which has not hitherto received the recognition it merits. Most readers, we fancy, will find much that is novel in this account. Dr. Forel's work on the subject was begun about a quarter of a century ago, but his researches, carried out on Lake Geneva with remarkable skill, have only been imitated elsewhere within the last year or two. There can be no doubt that highly important results will follow from the systematic application of Forel's methods which has been begun on Lake George, in New South Wales, and on the great lakes of North America. Not only will an appreciative description of Dr. Forel's work with those instruments of his own invention, the Plemyrameter and the Limnimeter, be found in this chapter, but also an excellent account of Mr. F. Napier Denison's application to this case of Helmholtz' theory of the waves generated at the surface of separation of two layers of fluid in relative motion. In dealing with the peculiar behaviour of the waters in tidal rivers, Captain Moore's work in observing the "bore" on the Tsieng-Tang-Kieng is described, and illustrated by reproductions from photographs.

At this point Prof. Darwin introduces an historical sketch, in composing which he has had the happy idea of levying contributions from his colleagues at Cambridge in the form of extracts from the early philosophical and mythological writers of such nationalities as Chinese and Arabic. Only after so much by way of introduction does he attack the mechanical theory. Admirably lucid chapters deal with the statics of the tide generating force and the deflection of the vertical. This provides an opportunity of describing his own researches with the bifilar pendulum on lunar gravity, of which this popular account is most welcome. This in turn leads to a short discussion of those seismological problems which are now attracting wide attention. The distortion of the earth's surface is also discussed as a disturbing factor in the problem of the direct measurement of the tidal force. The famous equilibrium theory of the tides is next examined, its value being insisted on as a statement of the statical conditions of the problem. But Prof. Darwin, unlike most of his predecessors among the popular writers on the subject, does not stop at this unsatisfactory stage, but goes on to consider the hydrodynamics of the tide-wave. Prof Darwin's treatment of free and forced waves in canals in different latitudes, and of tides in lakes and land-locked seas, leaves no ground for criticism, although it is impossible but that the unmathematical reader will find great difficulty in following the reasoning which the mathematician apprehends through the medium of differential equations. Any one who has fairly well mastered the foregoing chapters should have little difficulty in understanding the one in which Prof. Darwin expounds the great modern method of harmonic analysis, though here again it is scarcely possible for any but the mathematician to realise that this powerful theory leads to a unique solution of the problem, or, in other words, that it has any sounder foundation than juggling empiricism. A clear insight ought to be gained into the method by which tidal observations are reduced and made to provide the raw material for the tide-predicting machine. The practicability of tide prediction having been realised, it only remains to discuss the degree of accuracy which has been attained. This naturally leads to a consideration of the discrepancies, and the effects of wind and barometric pressure and the variation of latitude are discussed as disturbing factors. Thus the end is reached of that section of the book which deals with the subject in its more direct aspect.

It is impossible here to give any detailed account of the remaining contents of the book, although they are of absorbing interest and eminently capable of popular treatment. In masterly chapters Prof. Darwin examines the effects of tidal friction, and discusses those particular cases in which they seem to have been most clearly manifested. The chapter on the possible equilibrium figures of a rotating mass of liquid is a good example of the author's judgment in the arrangement of his material, beginning as it does with the more easily understood experiments of Plateau, and leading up to Poincaré's remarkable work. The Nebular Hypothesis as given here in outline by Prof. Darwin does not strain the limits of conceivability as it commonly does when expounded by less able writers, but is brought well within the bounds of rational probability. An excellent summary of those researches which have led to a definite and final conclusion as to the constitution of Saturn's rings, brings the whole work to a fitting termination.

The diagrams and illustrations, though not very numerous, are generally good and clear, with the possible exception of Fig. 23, which seems to need more explanation than is given. The bibliographical notes, which are appended to every chapter, give most valuable and copious reference to the original authorities. Prof. Darwin's book ought to be read by "all those whose minds are in any degree permeated by the scientific spirit" (preface): it is certain to excite the interest and appreciation of all such, and not least of the mathematician, in spite of the fact that there is not a mathematical symbol from one end to the other.

W. E. P.

FLORA OF ROUMANIA.

Conspectul Florei României. By Dr. D. Grecescu. Pp. xvi + 835. (Bucharest: Tipografiea Dreptatea, 1898.)

THIS is a valuable addition to our knowledge of the floras of the Balkan States. Prof. Grecescu's book supersedes Branza's "Prodromul Florei României," which so far has been the only comprehensive work on the flora of Roumania. Branza enumerated 2100 species, of which Grecescu admits 1875 as "good." These figures refer to Roumania, exclusive of Dobrudsha. Grecescu includes, of course, the latter, and records 2450 species besides 550 varieties. This very considerable increase is partly due to the addition of the Dobrudsha flora, partly to the admission of not a few of Schur's very questionable species and of other "species minutæ," but mainly, no doubt, to the more complete collections which were at the author's disposal. The author evidently worked under considerable difficulties. He had not only to accumulate the bulk of the material on which his work rests, but was also obliged at the same time to build up, as it seems, a general herbarium of European plants for comparison. It is only fair to mention this in order that we should not criticise too severely shortcomings which are inevitable under such conditions.

The book consists of two parts, of which the first contains the Conspectus proper, or the enumeration of the species found within the borders of the kingdom of Roumania, preceded by a synoptical table of the classes and orders; whilst the second part deals with the general physiography of the country and the principal vegetations and floras of Roumania. The author follows in the arrangement of the orders on the whole the system adopted in Nyman's "Conspectus Floræ Europeæ." Why he deviates from it in certain cases is difficult to understand, if it is not partly to suit his key of orders; but when he subdivides, for instance, the "Embriogene Dicotyledóne Apetale Unisexuate" (*i.e.* the unisexual Apetalæ) into "Angiosperme" and "Gymnosperme," including Gnetaceæ in the former, then he shows such a disregard of modern nomenclature and the results of modern taxonomy, that at least an attempt of explanation ought to have been made. In fact, it is always precarious to introduce taxonomic reforms of a higher order into local floras, and the author would have done far better if he had stuck right through to Nyman's "Conspectus."

The introductory chapters of the first part ("Clasificatiea generală" and "Dispositiea familiilor naturale") are altogether the weakest part of the work, and might have been just as well omitted as being outside the scope of the book. The same applies to the short diagnoses of the tribes, subgenera and more subordinate groups which are dispersed through the enumeration of the species. As neither the genera nor the species are diagnosed, the result is an imperfect key which is useless to the beginner who does not know the genera, whilst the more advanced student who knows them is equally puzzled, as it does not carry him far enough.

The terminology is sometimes rather loose; for instance, when the perianth of Plumbagineæ and Primulaceæ is described as "herbaceous," or the terms used are obsolete, *e.g.* when "perisperm" is applied, as it was originally by Jussieu to albumen generally. Other errors, as the description of the capsules of Primulaceæ as pyxidia generally, are evidently mere slips. On the other hand, innovations like the subdivision of Gramineæ in two tribes, Eugramineæ and Maydeæ, are quite unjustifiable.

The author distinguishes three principal zones of vegetation in Roumania, *i.e.* an Alpine zone, a forest zone and a steppe zone, and he considers Roumania as forming part of a greater and natural phytogeographical region, the region of the Flora Dacica, with the Southern Carpathians as the principal focus, and extending to the Theiss in the west, the Dniester in the east, and the Danube and the Black Sea in the south and south-east. This section of the book is of considerable interest, and it is to be regretted that the author has not accompanied it by a *résumé* in French, English or German. We are sure there are many botanists who are interested in the constitution and differentiation of the Roumanian flora, but to whom a book written in Roumanian does simply not exist. They would certainly be thankful if the author would publish a translation or a comprehensive abstract of the second part of his book in one of the languages mentioned. Either, we venture to suggest, would gain very much by a careful revision which will convince him that, for instance, the number of endemic species admitted in the Alpine zone of the Flora Dacica (fully 31 per cent.!) is far too high, or that many of the so-called Mediterranean elements can hardly claim this designation.

O. STAPF.

OUR BOOK SHELF.

De Danske Barkbiller (Scolytidae et Platypodidae Danicae). By E. A. Lövendal. Pp. xii + 212; plates 5. (Copenhagen, 1898.)

IN this work Mr. Lövendal, of the Copenhagen Museum, has written a most complete account of the Danish species of bark-beetles, a subject previously dealt with by him, principally with regard to its systematic side, in Meinert's "Entomologiske Meddelelser." No European family of beetles, relatively to its size, has given rise to a more copious literature, chiefly because of its important economic relations; and in Eichhoff's "Die Europäischen Borkenkäfer," we possess already an excellent treatise on the European species known at the date of that work.